

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☒ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☒ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER: \_\_\_\_\_**

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**



(19)

Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 1 041 189 A1

(12)

## EUROPEAN PATENT APPLICATION

(43) Date of publication:

04.10.2000 Bulletin 2000/40

(51) Int. Cl.<sup>7</sup>: D06L 1/04

(21) Application number: 00301475.0

(22) Date of filing: 24.02.2000

(84) Designated Contracting States:

AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE

Designated Extension States:

AL LT LV MK RO SI

(72) Inventors:

• Kilgour, John Alfred  
New York 12065 (US)

• Perry, Robert J.

Niskayuna, New York 12309 (US)

(30) Priority: 31.03.1999 US 282828

(71) Applicant:

GENERAL ELECTRIC COMPANY  
Schenectady, NY 12345 (US)

(74) Representative:

Szary, Anne Catherine, Dr. et al  
London Patent Operation,  
GE International, Inc.,  
Essex House,  
12-13 Essex Street  
London WC2R 3AA (GB)

(54) Dry cleaning composition and process

(57) A dry cleaning composition containing a cyclic siloxane and a siloxane surfactant and, optionally, water, as well as a method for dry cleaning comprising contacting an article with the composition are disclosed. The method removes both water and oil soluble stains from the article.

EP 1 041 189 A1

## Description

[0001] The present invention is directed to a composition, more specifically, to a siloxane fluid based composition, for use in dry cleaning and to a dry cleaning process using the composition.

[0002] Current dry cleaning technology uses perchloroethylene ("PERC") or petroleum-based materials as the cleaning solvent. PERC suffers from toxicity and odor issues. The petroleum-based products are not as effective as PERC in cleaning garments.

[0003] Cyclic siloxanes have been reported as spot cleaning solutions, see US 4,685,930. Other patents disclose the use of silicone soaps in petroleum solvents, see JP 09299687, and the use of silicone surfactants in super critical carbon dioxide solutions has been reported, see, for example, US 5,676,705 and Chem. Mark. Rep., 15 Dec 1997, 252(24), p. 15. Non-volatile silicone oils have also been used as the cleaning solvent requiring removal by a second washing with perfluoroalkane to remove the silicone oil, see JP 06327888.

[0004] Numerous other patents have issued in which siloxanes or organomodified silicones have been present as addenda in PERC or petroleum based dry cleaning solvents, see, for example, WO 9401510; US 4911853; US 4005231; US 4065258.

[0005] In a first aspect, the present invention is directed to a dry cleaning composition, comprising a cyclic siloxane and a siloxane surfactant.

[0006] In a second aspect, the present invention is directed to a method for dry cleaning an article, comprising contacting the article with a composition comprising a cyclic siloxane and a siloxane surfactant.

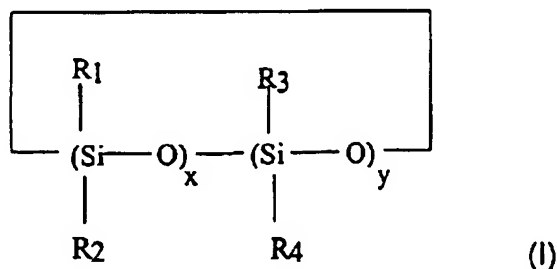
[0007] The process of the present invention effectively removes both oil soluble and water soluble stains from the article, for example a garment, being cleaned and suppresses redeposition of soil on the article.

[0008] In a preferred embodiment, the composition comprises, based on 100 parts by weight ("pbw") of the composition, from 80 pbw to 99.99 pbw, more preferably from 90 pbw to 99.9 pbw and even more preferably from 92 pbw to 99.5 pbw of the cyclic siloxane and from 0.01 pbw to 20 pbw, more preferably from 0.1 pbw to less than 10 pbw and even more preferably from 0.5 pbw to 8 pbw of the siloxane surfactant.

[0009] In a preferred embodiment, the composition further comprises, based on 100 pbw of the composition, up to 10 pbw, more preferably from 0.01 pbw to 10 pbw, even more preferably from 0.1 pbw to 5 pbw, even more preferably 0.5 pbw to 2 pbw water.

[0010] Compounds suitable as the cyclic siloxane component of the present invention are those containing a polysiloxane ring structure that includes from 2 to 20 silicon atoms in the ring. Preferably, the cyclic siloxanes are relatively volatile materials, having, for example, a boiling point of below about 250°C at a pressure of 760 millimeters of mercury ("mm Hg").

[0011] In a preferred embodiment, the cyclic siloxane comprises one or more compounds of the structural formula (I):



wherein:

R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup>, R<sup>4</sup> are each independently a monovalent hydrocarbon group; and x and y are each independently integers from 0 to 10, provided that 3 ≤ (x + y) ≤ 10.

[0012] Preferred monovalent hydrocarbon groups are monovalent alkyl groups, monovalent aryl groups and monovalent aralkyl groups, more preferably, the monovalent hydrocarbon group is a monovalent (C<sub>1</sub>-C<sub>6</sub>)alkyl group, most preferably, methyl.

[0013] As used herein, the term "(C<sub>1</sub>-C<sub>6</sub>)alkyl" means a linear or branched alkyl group, containing from 1 to 6 carbons per group, such as, for example, methyl, ethyl, propyl, iso-propyl, n-butyl, iso-butyl, sec-butyl, tert-butyl, pentyl, hexyl, preferably methyl.

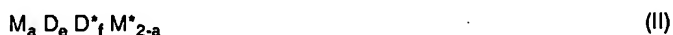
[0014] As used herein, the term "aryl" means a monovalent unsaturated hydrocarbon ring system containing one or more aromatic rings per group, which may optionally be substituted on the one or more aromatic rings, preferably with one or more (C<sub>1</sub>-C<sub>6</sub>)alkyl groups and which, in the case of two or more rings, may be fused rings, including, for example, phenyl, 2,4,6-trimethylphenyl, 2-isopropylmethylphenyl, 1-pentalenyl, naphthyl, anthryl, preferably phenyl.

5 [0015] As used herein, the term "aralkyl" means an aryl derivative of an alkyl group, preferably a (C<sub>2</sub>-C<sub>6</sub>)alkyl group, wherein the alkyl portion of the aryl derivative may, optionally, be interrupted by an oxygen atom, such as, for example, phenylethyl, phenylpropyl, 2-(1-naphthyl)ethyl, preferably phenylpropyl, phenoxypropyl, biphenyloxypropyl.

[0016] In a preferred embodiment, the cyclic siloxane comprises one or more of, octamethylcyclotetrasiloxane, decamethylcyclopentasiloxane, dodecamethylcyclohexasiloxane, tetradecamethylcycloheptasiloxane. In a more highly  
10 preferred embodiment, the cyclic siloxane of the present invention comprises decamethylcyclopentasiloxane. In a highly preferred embodiment, the cyclic siloxane component of the composition of the present invention consists essentially of decamethylcyclopentasiloxane.

[0017] Suitable cyclic siloxanes are made by known methods, such as, for example, hydrolysis and condensation of dimethyldichlorosilane and are commercially available.

15 [0018] In a preferred embodiment, the siloxane surfactant component of the present invention comprises one or more polyether siloxane compounds according to the structural formula II:



20 wherein:

M is R<sup>5</sup><sub>3</sub>SiO<sub>1/2</sub>;

D is R<sup>6</sup><sub>2</sub>SiO<sub>2/2</sub>;

25

M\* is R<sup>7</sup><sub>3</sub>SiO<sub>1/2</sub>;

D\* is R<sup>8</sup><sub>2</sub>SiO<sub>2/2</sub>;

30

each R<sup>5</sup>, R<sup>6</sup> is independently H, or a monovalent hydrocarbon group,

each R<sup>7</sup> is independently H, a monovalent hydrocarbon group, or (CH<sub>2</sub>)<sub>g</sub>-O-(C<sub>2</sub>H<sub>4</sub>O)<sub>h</sub>-(C<sub>3</sub>H<sub>6</sub>O)<sub>i</sub>-(C<sub>n</sub>O<sub>2n</sub>O)<sub>j</sub>-R<sup>11</sup>,  
provided that at least one R<sup>7</sup> is (CH<sub>2</sub>)<sub>g</sub>-O-(C<sub>2</sub>H<sub>4</sub>O)<sub>h</sub>-(C<sub>3</sub>H<sub>6</sub>O)<sub>i</sub>-(C<sub>n</sub>O<sub>2n</sub>O)<sub>j</sub>-R<sup>11</sup>;

35

each R<sup>8</sup> is independently H, a monovalent hydrocarbon group, or (CH<sub>2</sub>)<sub>g</sub>-O-(C<sub>2</sub>H<sub>4</sub>O)<sub>h</sub>-(C<sub>3</sub>H<sub>6</sub>O)<sub>i</sub>-(C<sub>n</sub>O<sub>2n</sub>O)<sub>j</sub>-R<sup>11</sup>,  
provided that at least one R<sup>8</sup> is -(CH<sub>2</sub>)<sub>g</sub>-O-(C<sub>2</sub>H<sub>4</sub>O)<sub>h</sub>-(C<sub>3</sub>H<sub>6</sub>O)<sub>i</sub>-(C<sub>n</sub>O<sub>2n</sub>O)<sub>j</sub>-R<sup>11</sup>;

R<sup>11</sup> is H, a monovalent hydrocarbon group or alkyloxy;

40

0 ≤ a ≤ 2;

0 ≤ e ≤ 1000;

0.1 ≤ f ≤ 50;

45

1 ≤ g ≤ 16;

0 ≤ h ≤ 30;

50

0 ≤ i ≤ 30;

0 ≤ j ≤ 30; and

4 ≤ n ≤ 8

55

provided that h + i + j > 0.

[0019] In a preferred embodiment, 2 ≤ h ≤ 25, 0 ≤ i ≤ 25 and 0 ≤ j ≤ 25, more preferably j is 0.

Rating	5 = complete removal of stain
	4 = slight stain remaining
	3 = moderate stain removal
	2 = slight stain removal
	1 = no stain removal

[0027] The amounts of D<sub>5</sub>, polyether siloxane and water used in each of Examples 1-56 and Comparative Examples C1-C4, the type of stain and the results obtained are set forth in TABLES I-IV below.

TABLE I

Exp #	D <sub>5</sub> , Amount (g)	Stain	Polyether Siloxane	Polyether Siloxane, Amount (g)	H <sub>2</sub> O, Amount (g)	Cleaning
C1	49.5	Salt	--	--	--	2.3
1	49.5	Salt	A	0.5	--	3.7
2	49	Salt	A	0.5	0.5	4.7
3	49.5	Salt	F	0.5	--	3.7
4	49	Salt	F	0.5	0.5	3.7
5	49.5	Salt	B	0.5	--	4
6	49	Salt	B	0.5	0.5	4
7	49.5	Salt	C	0.5	--	4.7
8	49	Salt	C	0.5	0.5	4
9	49.5	Salt	D	0.5	--	4
10	49	Salt	D	0.5	0.5	2.7
11	49.5	Salt	E	0.5	--	4.7
12	49	Salt	E	0.5	0.5	4.3
13	49.5	Salt	B/E	0.25/0.25	--	2.7
14	49	Salt	B/E	0.25/0.25	0.5	4

TABLE II

Exp #	D <sub>5</sub> , Amount (g)	Stain	Polyether Siloxane	Polyether Siloxane, Amount (g)	H <sub>2</sub> O, Amount (g)	Cleaning
C2	47.5	Salt	--	--	--	2.7
15	47.5	Salt	A	2.5	--	5
16	47	Salt	A	2.5	0.5	5
17	47.5	Salt	F	2.5	--	3
18	47	Salt	F	2.5	0.5	4.3
19	47.5	Salt	B	2.5	--	5

EP 1 041 189 A1

TABLE II (continued)

Exp #	D <sub>5</sub> , Amount (g)	Stain	Polyether Siloxane	Polyether Siloxane, Amount (g)	H <sub>2</sub> O, Amount (g)	Cleaning
20	47	Salt	B	2.5	0.5	5
21	47.5	Salt	C	2.5	--	4
22	47	Salt	C	2.5	0.5	4.7
23	47.5	Salt	D	2.5	--	5
24	47	Salt	D	2.5	0.5	5
25	47.5	Salt	E	2.5	--	4.7
26	47	Salt	E	2.5	0.5	4.7
27	47.5	Salt	B/E	1.25/1.25	--	3
28	47	Salt	B/E	1.25/1.25	0.5	3.7

TABLE III

Exp #	D <sub>5</sub> , Amount (g)	Stain	Polyether Siloxane	Polyether Siloxane, Amount (g)	H <sub>2</sub> O, Amount (g)	Cleaning
C3	49.5	Oil	--	--	--	4
29	49.5	Oil	A	0.5	--	5
30	49	Oil	A	0.5	0.5	4
31	49.5	Oil	F	0.5	--	5
32	49	Oil	F	0.5	0.5	5
33	49.5	Oil	B	0.5	--	4.7
34	49	Oil	B	0.5	0.5	3.7
35	49.5	Oil	C	0.5	--	4
36	49	Oil	C	0.5	0.5	3
37	49.5	Oil	D	0.5	--	3.7
38	49	Oil	D	0.5	0.5	5
39	49.5	Oil	E	0.5	--	5
40	49	Oil	E	0.5	0.5	5
41	49.5	Oil	B/E	0.25/0.25	--	4.7
42	49	Oil	B/E	0.25/0.25	0.5	5

TABLE IV

Exp #	D <sub>5</sub> , Amount (g)	Stain	Polyether Siloxane	Polyether Siloxane, Amount (g)	H <sub>2</sub> O, Amount (g)	Cleaning
C4	47.5	Oil	--	--	--	4
43	47.5	Oil	A	2.5	--	5

TABLE IV (continued)

Exp #	D <sub>5</sub> , Amount (g)	Stain	Polyether Siloxane	Polyether Siloxane, Amount (g)	H <sub>2</sub> O, Amount (g)	Cleaning
44	47	Oil	A	2.5	0.5	5
45	47.5	Oil	F	2.5	--	5
46	47	Oil	F	2.5	0.5	5
47	47.5	Oil	B	2.5	--	5
48	47	Oil	B	2.5	0.5	5
49	47.5	Oil	C	2.5	--	5
50	47	Oil	C	2.5	0.5	4
51	47.5	Oil	D	2.5	--	5
52	47	Oil	D	2.5	0.5	5
53	47.5	Oil	E	2.5	--	5
54	47	Oil	E	2.5	0.5	5
55	47.5	Oil	B/E	1.25/1.25	--	5
56	47	Oil	B/E	1.25/1.25	0.5	4.5

# Claims

1. A dry cleaning composition, comprising a cyclic siloxane and a siloxane surfactant.
2. A method for dry cleaning an article, comprising contacting the article with a composition comprising a cyclic siloxane and a siloxane surfactant.



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 00 30 1475

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (InCL7)
E	US 6 063 135 A (BERNDT DIETER R ET AL) 16 May 2000 (2000-05-16) * claims 1,2 *	1,2	D06L1/04
A	DE 37 39 711 A (KREUSSLER CHEM FAB) 8 June 1989 (1989-06-08) * abstract *	1,2	
D,A	US 5 676 705 A (RESCH CAROL ET AL) 14 October 1997 (1997-10-14) * abstract *	1,2	
D,A	EP 0 609 456 A (DAIKIN IND LTD) 10 August 1994 (1994-08-10) * abstract *	1,2	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (InCL7) D06L
Place of search THE HAGUE		Date of completion of the search 18 July 2000	Examiner Saunders, T
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/02 (PULC01)



**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 30 1475

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

18-07-2000

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 6063135	A	16-05-2000	US 5942007 A	24-08-1999
			US 5865852 A	02-02-1999
			AU 4993599 A	07-02-2000
			AU 5101799 A	07-02-2000
			WO 0004221 A	27-01-2000
			WO 0004222 A	27-01-2000
			US 6042617 A	28-03-2000
			US 6056789 A	02-05-2000
			US 6042618 A	28-03-2000
			US 6059845 A	09-05-2000
DE 3739711	A	08-06-1989	NONE	
US 5676705	A	14-10-1997	AU 4942996 A	23-09-1996
			CA 2211412 A	12-09-1996
			WO 9627704 A	12-09-1996
			EP 0813628 A	29-12-1997
			FI 973603 A	05-09-1997
			US 5683473 A	04-11-1997
EP 0609456	A	10-08-1994	US 5883067 A	16-03-1999
			WO 9401510 A	20-01-1994

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☒ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**